

**Definition**

*Hemoptysis* is the expectoration of blood or blood-tinged sputum from the lungs or tracheobronchial tree.

**Technique**

Hemoptysis is an important symptom that elicits fear in both the patient and physician. Work-up for this symptom should be undertaken immediately unless the problem is both mild and recurrent, in which case a conservative approach may sometimes be preferable.

A thorough history may help define not only the site but also the cause of bleeding. When evaluating hemoptysis, the first step is to convince yourself that the lower respiratory tract is the source of the bleeding. Coughing is important because nonpulmonary sources of bleeding are not usually associated with hemoptysis. Questions regarding epistaxis and spitting blood without coughing help rule out the upper respiratory tract as the source of bleeding, but do not replace a thorough nose and throat examination. Further, the physician must be convinced that the bleeding is not of gastrointestinal origin. A history of nausea, vomiting, heartburn, and abdominal pain may be helpful, but occasionally the differential diagnosis is difficult and requires either direct observation of the patient's hemoptysis or endoscopic evaluation of the upper gastrointestinal tract.

The physician should quantify the amount of bleeding that has taken place, being as specific as possible (e.g., a teaspoon, a cupful). Patients and physicians usually overestimate the amount of bleeding, so nothing can replace direct observation. The approximate rate of bleeding requires careful quantification. Because the rapidity and the extent of the work-up depend to a large degree on the above quantification, the importance of this aspect of the history cannot be overemphasized.

Note if this is the first episode of hemoptysis or whether it is a chronic and/or recurrent problem. The quantity of past bleeding and the extent of previous evaluations are quite helpful. Despite the fact that repeated evaluations for recurrent hemoptysis are often advocated by experts, such evaluations can be both expensive and unrewarding in many patients.

One should next investigate thoroughly the material being produced. Is the patient coughing up bright red blood or blood clots (as in carcinoma of the lung, tuberculosis, pulmonary embolism); blood-streaked, purulent sputum (as in bronchitis, bronchiectasis, or pneumonia); blood-tinged, white, frothy sputum (as in congestive heart failure); or foul-smelling, bloody sputum (as in an anaerobic lung abscess)? Red sputum that contains no blood is seen in a rare case of *Serratia marcescens* pneumonia with its red pigmentation, in glass sanders with sputum discolored by iron oxide, and in ruptured hepatic amebic liver abscess with its "anchovy

paste" sputum. Rarely, a patient will present with pseudo-hemoptysis created artificially by various means.

Associated pulmonary symptoms such as chronic cough with sputum production, change in cough, shortness of breath on exertion, chest pain (especially of a pleuritic nature), and wheezing are also important in the evaluation of hemoptysis. The relation between these symptoms and the onset of hemoptysis can be quite helpful. For example, hemoptysis in lung cancer or tuberculosis usually is a late symptom preceded by weight loss, change in cough, fatigue, and other chronic symptoms.

Other points of the history that must be addressed include previous pulmonary infections, recent blunt chest trauma, seizures, and lower extremity pain or swelling; exposure to such agents as cigarette smoke, alcohol, asbestos, and tuberculosis; use of medications (e.g., anticoagulants); and finally, systemic symptoms such as fever, weight loss, and other bleeding problems, especially hematuria (Table 39.1). The age of the patient is also useful in narrowing the differential diagnosis. Cystic fibrosis is a disease of children and young adults; mitral stenosis, bronchial adenomas, Goodpasture's syndrome, and primary pulmonary hypertension occur in the middle aged; and carcinoma of the lung is usually seen in patients over 50 years of age.

**Basic Science**

Depending on the underlying disease, hemoptysis is a result of several different pathologic mechanisms. Remember that the lung contains two separate vascular systems: the pulmonary and the bronchial vessels. Hemoptysis can occur with involvement of either.

Infarction of lung tissue with hemoptysis can occur in numerous diseases. Pulmonary emboli often present with hemoptysis as a result of ischemic pulmonary parenchymal necrosis. A similar ischemic necrosis can be seen in all idiopathic vasculitides involving the pulmonary vessels, including Wegener's granulomatosis. Infections causing blood vessel invasion with infarction include primarily *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Aspergillus fumigatus*, and the phicomycetes.

**Table 39.1**  
Important Points of the History in Hemoptysis

Symptoms of upper respiratory or gastrointestinal disease
Quantity and rate of bleeding
Previous hemoptysis, including extent of previous evaluations
Appearance of sputum
Other pulmonary symptoms (e.g., chronic cough, chest pain)
Other systemic symptoms (e.g., fever, weight loss)
Other bleeding problems
Toxic exposures, especially cigarette smoke

Vascular engorgement with erosion is another mechanism of hemoptysis. This occurs within the bronchial capillaries in the mucosa of the tracheobronchial tree as a result of acute infection such as viral or bacterial bronchitis, chronic infection such as bronchiectasis, or a toxic exposure such as cigarette smoke. The shearing force of coughing can result in bleeding.

Local hyperemia is seen in the common bacterial pneumonias such as *Streptococcus pneumoniae*. Vascular congestion is followed by red hepatization of the lung where alveoli are filled with blood-tinged fluid and bacteria to which neutrophils and fibrin are added. This results in the production of the rust-colored, purulent sputum classically seen in pneumococcal pneumonia. A similar situation is found in contusion of the lung with exudation of blood and fluid into the alveoli. Of course, the purulent nature of the sputum is absent in this situation.

Vascular engorgement of dilated bronchial vessels, along with anastomoses between the pulmonary and bronchial circulations, occurs in tuberculosis, bronchiectasis, lung abscesses, and cystic fibrosis. Resulting erosion and rupture of the pulmonary capillaries or adjacent bronchial arteries leads to hemoptysis that can be massive. Rupture of a Rasmussen's aneurysm (a dilated bronchial vessel in the wall of a tuberculous cavity) is a relatively rare cause of hemoptysis.

Necrosis of pulmonary parenchyma can be seen in chronic infections such as tuberculosis and in malignant tumors of the lung. The latter can also cause bleeding by outgrowing their blood supply with resultant tumor necrosis, as well as by bronchial mucosal invasion (also seen in tuberculosis). Large vessel invasion can rarely result in massive hemoptysis.

Disruption of the pulmonary capillaries can be seen either as a result of increased intravascular pressure (as in mitral stenosis and left ventricular failure) or as a result of disruption of the alveolocapillary basement membrane from the ant basement membrane antibody seen in Goodpasture's syndrome.

Aspergillomas are frequently associated with hemoptysis. Local friction from the moving fungus ball, reactive capillary proliferation with bronchiopulmonary anastomoses, and release of a proteolytic enzyme are all postulated as having a role in the etiology of the bleeding.

## Clinical Significance

Hemoptysis must always be considered a serious and potentially lethal complication of the underlying process. When an aggressive approach is taken in the evaluation of hemoptysis, a cause can be determined in approximately 90% of cases. Table 39.2 outlines the main causes of hemoptysis. Marked variation is seen from center to center depending on whether inpatients or outpatients are categorized, whether tuberculosis is prevalent, and whether one is evaluating surgical or medical patients.

The amount of bleeding is useful in the differential diagnosis of hemoptysis. More benign processes such as bronchitis and pneumonia cause the majority of all cases of hemoptysis, but they are less common as the severity of the bleeding increases. Massive hemoptysis is most commonly associated with lung cancer, bleeding diathesis (e.g., leukemia during chemotherapy, anticoagulation), cystic fibrosis, and tuberculosis.

A more complete (but by no means exhaustive) list of causes is given in Table 39.3 and helps one formulate an

**Table 39.2**  
Major Causes of Hemoptysis

Cause	All	Major (>200 cc/24 hr)	Massive (>1000 cc/24 hr)
Bronchitis	50%	25%	0-7%
Bronchiectasis	0-5	0-15	0-5
Pneumonia	10	0-5	1-2
Lung abscess	0-5	0-5	0-5
Tuberculosis	3-5	3-70	3-70
Lung cancer	10-15	20	30
Congestive heart failure	0-5	0-5	1-2
Other <sup>a</sup>	10	20-40	10-50
Unknown	10	10	10

<sup>a</sup>Includes anticoagulation, leukemia, metastatic neoplasm, and cystic fibrosis.

approach to the physical examination. A young healthy woman with chronic hemoptysis may well have a bronchial adenoma, but the same patient presenting with dyspnea and hemoptysis may have mitral stenosis or primary pulmonary hypertension; mucocutaneous telangiectasis are often seen in Osler-Weber-Rendu syndrome; putrid sputum in an alcoholic or seizure patient points toward a lung abscess. Streak hemoptysis in a chronic smoker is often due to bronchitis, but carcinoma of the lung must always be ruled out, especially when the patient has associated symptoms such as weight loss. Chronic cough with fever and weight loss complicated by hemoptysis can be seen both in tuberculosis and bronchiectasis, although the latter often has more marked sputum production. A systemic disease resulting in hemoptysis points toward a vasculitis or Goodpasture's syndrome.

Therapy depends on the underlying process and the rate of hemoptysis. Amounts greater than 1000 ml in 24 hours calls for an aggressive diagnostic approach. The risk of dying with this degree of hemoptysis, however, rests primarily on the underlying disease. Bronchitis and bronchiectasis have a low mortality even with this amount of bleeding, whereas patients with tuberculosis, lung cancer, and lung abscesses

**Table 39.3**  
Common Causes of Hemoptysis

Arteriovenous malformations
Bleeding diathesis
Bronchial adenoma
Bronchiectasis
Bronchitis
Bronchogenic carcinoma
Cystic fibrosis
Goodpasture's syndrome
Leukemia
Lung abscess
Metastatic neoplasm
Mycetoma
Pneumoconiosis
Pneumonia
Primary pulmonary hypertension
Pulmonary edema due to left ventricular failure or mitral stenosis
Pulmonary infarction
Trauma
Tuberculosis
Wegener's granulomatosis

have a higher risk. Therapy is controversial and is usually nonsurgical except in a small group of patients with a resectable lesion on chest roentgenogram and respiratory or hemodynamic failure.

## References

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